PATENT ABSTRACTS OF JAPAN

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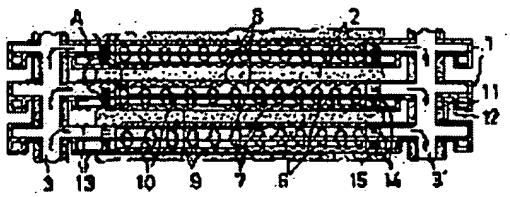
(54) FUEL CELL

(57)Abstract:

PURPOSE: To provide a fuel cell of a high reliability at a low cost by eliminating requirements imposed on a separator constituent member about high accuracy of fabrication,

CONSTITUTION: A spring member 14 is inserted between an edge plate 13 of a separator 1 and a separator plate 10 to accomplish a soft structure, and thereby eventual dimensional error between the electromotive part when they are stacked and the edge plate 13 of separator 1 can easily be absorbed by deformation of the spring member 14, which eliminates requirement about high accuracy of fabrication. The rigidity of the edge is lowered by forming the spring member 14 from a plurality of projecting pieces which are supported by the separator 1 in cantilever form. which makes it easier to absorb the dimensional error perfectly. High fabrication accuracy is no more required of the separator 1 by extending the edge plate 13 so as to overlap in the plane direction on electrodes 8, 9 in the adjacent separator 1 and current collectors 6, 7. Thus the costs cure suppressed, and the sealing performance is enhanced.



LEGAL STATUS

[Date of request for examination] 22.12.1998

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the fuel cell which carried out two or more laminatings configuration of the unit cell.
[0002]
[Description of the Prior Art] In the fuel cell which transforms chemical energy into direct electrical energy, forward and negative two electrodes are prepared in contact with both sides of an electrolyte plate, and a unit cell is formed by making oxidant gas and fuel gas react, respectively. By the way, since the electromotive force acquired is low, in order to constitute the power generating plant of high power from a unit cell, it is necessary to carry out the laminating of two or more unit cells to a serial, to constitute a fuel cell layered product, and to obtain the addition output of each unit cell.
[0003] Generally, a separator is formed between the unit cells by which a fuel cell layered product adjoins each other, and the configuration which classifies the fuel gas passage (or oxidant gas passage) of one unit cell and the oxidant gas passage (or fuel gas passage) of the unit cell of another side is taken. Furthermore, into a separator, laminating arrangement of the current collector (collecting electrode plate) and electrode which have conductivity on both sides of a separator plate is carried out.
[0004] Thus, after laminating arrangement is carried out, on both sides of an electrolyte plate, the laminating of each separator will be carried out to order. Therefore, the laminating of an oxidant gas way and the fuel gas way will be carried out by turns, and they become important [forming a feeding-and-discarding way] in the manifold which supplies each gas, without [without each gas leaks outside, and] mixing each gas. And KUROSURI-KU resulting from the crack of an electrolyte plate etc. needs to be prevented in advance. Drawing 25 shows the cross section of the conventional fuel cell layered product.
[0005] As shown in this drawing 25 , the laminating of á separator 1 and the electrolyte plate 2 is carried out by turns, and they form the stack. The manifolds 3 and 4 (3', 4') which are feeding-and-discarding Deji of oxidant gas and fuel gas are formed in the both ends of a layered product, and the role which circulates each gas to the reaction section 5 (equivalent to the electromotive section) is borne.
[0006] Drawing 26 is a sectional view in alignment with Y-Y of drawing 25 . The oxidant gas supplied to the manifold 3 passes along the inside of the current collector 6 which forms oxidant gas passage, and a generation-of-electrical-energy operation is presented with it in the meantime, and it is discharged by manifold 3'. On the other hand, fuel gas is supplied to a manifold 4, passes along the inside of a current collector 7, and a generation-of-electrical-energy operation is presented with it in the meantime, and it is discharged to manifold 4'. An electrolyte plate 2 is put, a unit cell is constituted from the reaction section by an anode 8, a cathode 9, and current collectors 6 and 7, and each unit cell is classified with the separator plate 10.
[0007] Therefore, each gas is closed with an electrolyte plate 2 and the separator plate 10, and closure is made around the reaction section 5 with the wet seal in the contact section of an electrolyte plate 2 and a separator 1. Here, the seal element 12 which comes to seal an insulating member 11 is formed in the manifold section, and the isolated configuration is taken with the electromotive section.
[0008]
[Problem(s) to be Solved by the Invention] Thus, in the fuel cell with which it comes to carry out the laminating configuration of two or more unit cells, supply and to discharge are required, without mixing ring main, without oxidant gas and fuel gas leaking to the exterior. Furthermore, it is also important that the laminating process at the time of a fabrication is carried out with a sufficient precision simple moreover.
[0009] About especially mixing with oxidant gas and fuel gas, it becomes the reaction of hydrogen and oxygen and positive prevention is needed. In the conventional technique, as mentioned above, the method of closing a wet seal was

adopted for the closing method with an electrolyte plate and a separator plate in the contact section of an electrolyte plate and a separator by the reaction section. By the way, by the method of closing former, it is required for an electrolyte plate for a crack not to occur, and in order to cancel the mismatch on a dimension between the electromotive section and the edge section of a separator especially, a high fabrication precision is required and we are anxious about aggravation of the yield, buildup of fabrication cost, etc.

[0010] In the edge section of a separator which has rigid high structure as especially shown in drawing 26 , by the tolerance at the time of a fabrication, rather than the electromotive section, when the direction of the edge section has high height, the leakage of reactant gas is prevented, but since most bolting loads are applied to the edge section, the contact resistance in the electromotive section becomes large, and a cell output declines. Moreover, although contact of the electromotive section becomes good from the electromotive section when the direction of the edge section has low height, the leakage of the reactant gas from the edge section arises. Moreover, the height of the edge section is high at the one side which sandwiched the electrolyte plate, and when low at the other side, the crack of an electrolyte plate will arise on the boundary of the edge section and the electromotive section. Therefore, it is necessary to make severe management of the level difference of the electromotive section and the edge section, and we are anxious about aggravation of the yield, and buildup of fabrication cost. In the closing method by the latter wet seal, a high fabrication precision is similarly demanded from the engine performance receiving effect in the wettability of a carbonate, welding pressure, etc.

[0011] It was made in order that this invention might solve the trouble of the above-mentioned conventional technique, and the mismatch on the dimension between the electromotive section and the edge section of a separator is canceled, and it aims at offering the fuel cell which release from a high fabrication precision, improvement in the yield, reduction of fabrication cost, and improvement in a wet seal can attain.

[0012]

[Means for Solving the Problem] In the fuel cell constituted by carrying out two or more laminatings of the unit cell which consists of a current collector which forms a gas way in contact with the positive electrode which comes to contact an electrolyte plate and its both sides and a negative electrode, and each [these] electrode through a separator While constituting said separator from sheet metal, moreover by having arranged the elastic member between the edge section of the separator which forms a wet seal in contact with an electrolyte plate, and a separator plate, a reliable fuel cell is attained by low cost. Furthermore, said elastic member is characterized by consisting of two or more protruding pieces by which the cantilevered suspension was carried out to said separator.

[0013] Furthermore, the effectiveness is expanded, when the wire extension by the side of the electromotive section in the edge section which forms a wet seal in contact with the electrolyte plate of a separator spreads until one side has a lap in difference compared with the side else in a long configuration, the electrode further constituted by the electromotive section, a current collector, and the direction of a flat surface by it of the side which touches through the electrolyte plate of a contiguity separator.

[0014] Moreover, when the direction of the side spread until it had the lap in the electrode, the current collector, and the direction of a flat surface makes the spring height or spring strength to insert highly or large compared with the side else, the effectiveness is attained more easily.

[0015]

[Function] By adopting the separator which inserted the elastic member between the edge section and a separator plate, while constituting the separator infix between unit cells from sheet metal according to this invention, edge section height becomes possible [changing with deformation of an elastic member easily], and the mismatch on the dimension between the electromotive section at the time of a stack laminating and the edge section of a separator is reduce, and, therefore, becomes unnecessary [a high fabrication precision].

[0016] Moreover, by using the protruding piece by which the cantilevered suspension was carried out especially as an elastic body, the protruding piece by which the cantilevered suspension was carried out can bend to a predetermined load, can take a sufficiently large amount, and can make rigidity of the edge section sufficiently lower than the electromotive section.

[0017] Furthermore, when closure by the wet seal also adjusts its spring height and strength suitably, suitable planar pressure for the basis of the service condition by the side of compression is made, and improvement in dependability is attained.

[0018] Moreover, by spreading until it has a lap in the electrode and the current collector, and the direction of a flat surface which are constituted by other near electromotive sections in one near edge section wire extension of an adjoining separator At the time of a stack laminating, on the conditions that the spring height of a side with a wire extension long at least is high or that spring strength is large, the deformation of the edge section is restrained from the lap, and, therefore, fear of the crack of an electrolyte plate is reduced by half.

[0019] furthermore , when the direction of the side spread until it had the lap in the electrode and the current collector , and the direction of a flat surface make highly or large the spring height or spring strength constitute between the edge section of a separator , and a separator plate compared with the side else , also in the conditions which lowered fabrication precision , fear of the crack of an electrolyte plate be prevent in advance , and become unnecessary [a high fabrication precision] simpler . A dimension error is absorbable with contraction of the edge section at the time of the assembly of a fuel cell layered product by setting up the height of the edge section especially more highly than the height of the electromotive section. Thus, a reliable fuel cell becomes possible by low cost.
[0020]
[Example] With reference to a drawing, one example of this invention is explained to a detail below.
[0021] Drawing 1 and drawing 2 are the sectional views showing one example of the fuel cell layered product about this invention, and the Y-Y line of drawing 25 of the former [drawing 1] and drawing 2 are sectional views to show this invention in the same location as the Z-Z line of drawing 25 similarly.
[0022] The laminating of a separator 1 and the electrolyte plate 2 is carried out by turns, and the fuel cell is constituted. The separator 1 consists of sheet metal (it is 0.3mm - about 0.5mm in thickness at magnitude 1000mmx1000mm), and the edge plate 13 (equivalent to the edge section) which carried out the separator plate 10 in the center, and was cast by the both sides by press working of sheet metal etc. seals it by welding (for example, Tig welding, laser welding, etc.) or soldering, and it is joined.
[0023] Moreover, like the conventional example, it seals and the seal element 12 which it comes to seal through an insulating member 11 is attached in the manifold section so that it may supply and discharge oxidant gas and fuel gas respectively between ****** separators. The spring member 14 which has elasticity is inserted between the contact section 15 of the periphery of an electrolyte plate 2, and the edge plate 13 of a separator 1, and the separator plate 10, and the suitable pressure for the contact section 15 is given. This spring member 14 not only does not bar each gas passageway, but is acting as a pressure-loss component for the uniform ** style to the reaction section 5 (rectifying device). The function as this pressure-loss component is explained with reference to drawing 3 .
[0024] drawing 3 -- being shown -- as -- an edge -- a plate -- 13 -- electromotive -- the section -- five -- corresponding -- a center section -- a core -- for example, -- four -- ways -- a spring -- a member -- 14 -- having arranged -- a case -- an edge -- a plate -- 13 -- a corner -- preparing -- having had -- each -- gas -- supply -- ** -- a manifold -- three -- blowdown -- ** -- a manifold -- three -- ' -- each -- the diagonal line -- ** -- physical relationship -- preparing -- having -- ******** . However, gas becomes easy to flow along a diagonal line top respectively, and, as for the part of a corner, gas cannot flow easily. Then, it is rectified and gas becomes easy to flow to homogeneity by arranging at least the spring member 14 of the configuration mentioned later immediately after the manifold 3 for supply (immediately after a gas flow direction) along with the longitudinal direction in drawing of the edge plate 13 (an arrow head S shows in drawing 3). If the pressure loss in this case is the spring member 14 of structure as shown in drawing 4 thru/or drawing 21 , it will be very small satisfactory. Thus, the operation which makes homogeneity equalize a sink and an electromotive reaction for gas can be produced by arranging the small member (spring member 14) of pressure loss immediately after the manifold 3 for gas supply. Next, the spring member 14 by which it is characterized by this invention is explained.
[0025] When drawing 4 and drawing 5 show the concrete example of structure of the spring member 14 applied to this invention and drawing 4 casts the sheet metal material of one sheet, drawing 5 shows the example which carried out the laminating of the two sheets and constituted them. As the molding approach, it can cast by the processing approaches, such as press working of sheet metal, bending, and cutting, easily. The spring member 14 shown in drawing 4 is the spring element of the configuration which formed heights 14a and crevice 14b by turns.
[0026] Moreover, the example of the bilayer configuration shown in drawing 5 can be easily manufactured by installing spring member 14A and 14B which were manufactured with one mold in the reverse sense, when carrying out the laminating of the spring member 14 to a bilayer, for example, carrying out by press working of sheet metal.
[0027] Moreover, even if gap arises between each class by adjusting a crest pitch etc. suitably, it can prevent fitting into each other and it is possible for the configuration which does not change the laminating height. Furthermore, what is necessary is it to be also possible for to consider as the configuration of three layers or four layers or more, without being limited to a bilayer configuration, and just to opt for these configurations synthetically from viewpoints, such as planar pressure, dimensional accuracy and a creep property required for a wet seal, and a life.
[0028] Moreover, without also limiting the configuration to the configuration of the example of drawing 4 or drawing 5 , the shape of the shape of a sine wave (wave type) and a semicircle etc. is suitably selectable, and may arrange a wave washer etc. suitably.
[0029] Next, the concrete structure for which especially the spring member 14 applied to this invention was suitable is explained. That is, in the case of the structure shown in drawing 4 or drawing 5 , in order to acquire the flexible

property needed, there is a possibility that a design condition may become severe, and the example explained below shows the configuration of the spring member 14 where a sufficiently flexible property is acquired simply. Drawing 6 is the amplification top view of the spring member 14 arranged between the edge plates 13 of a separator 1 and the separator plates 10 which were explained above. The spring member 14 consists of substrates 24, such as a stainless steel plate, and two or more protruding piece 24a is formed in the whole surface side of this substrate 24.
[0030] Detail ****** of these protruding pieces 25 is explained below. Drawing 7 is I-I [in / it is the enlarged drawing of C part of drawing 6 , and / in drawing 8 / drawing 6]. It is a line view sectional view. As shown in drawing 7 and drawing 8 , while separating the methods of three from a substrate 24 and causing aslant, bow molding of the point 25a is carried out in the direction of a substrate 24. Thus, the constituted protruding piece 25 is supported by the substrate 24 in those end face section 25b at a cantilever, and the above causes, and transparent window 25c is formed by the back. Thus, with the protruding piece 25 by which the cantilevered suspension was carried out, **** of the spring member 14 can be set up greatly and a dimension error can be absorbed thoroughly.
[0031] Moreover, drawing 9 is I-I [in / the modification of drawing 8 is shown and / drawing 6]. It is equivalent to a line view sectional view. As shown in drawing 9 , a protruding piece 25 can cause, a direction is constituted from protruding piece 25 adjacent comrades to hard flow, and in addition to this, it can arrange in both-sides side of a substrate 24, or it can be carried [it can deform suitably and] out. Drawing 10 is the top view showing the modification of the spring member 14, and drawing 11 is the II-II line view sectional view of drawing 10 , and attaches and explains the same sign to the same part as drawing 6 .
[0032] In this example, a substrate 24 is cut open and caused to zygal and two or more pairs of protruding pieces 25 are arranged in the whole surface side of a substrate 24. Also in this example, with the protruding piece 25 by which the cantilevered suspension was carried out to the substrate 24 in end face section 25b, **** of the spring member 14 can be set up greatly and a dimension error can be absorbed thoroughly.
[0033] Moreover, drawing 12 and drawing 13 show a modification respectively, and are the II-II line view sectional view of drawing 10 . this deformation ****** -- a protruding piece 25 causes like, and a direction etc. can deform suitably and can be carried out. Drawing 14 is the top view showing other examples of the spring member 14, and drawing 15 is the III-III line view sectional view of drawing 14 , and attaches and explains the same sign to the same part as drawing 6 .
[0034] In this example, two or more pairs of protruding pieces 25 which constitute the shape of a triangle are caused in a substrate 24, and it arranges in the whole surface side of a substrate 24. Also in this example, with the protruding piece 25 by which the cantilevered suspension was carried out to the substrate 24 in end face section 25b, **** of the spring member 14 can be set up greatly and a dimension error can be absorbed thoroughly. Moreover, since the protruding piece 24 of the shape of this triangle is formed so that a triangular top-most-vertices part may counter, transparent window 25c formed in a substrate 24 can become a square (for example, square), can reduce the rigidity of a substrate 24 uniformly two-dimensional, and can also make contact pressure equalize.
[0035] In addition, drawing 16 shows a modification and is the III-III line view sectional view of drawing 14 . this deformation ****** -- a protruding piece 25 causes like, and a direction etc. can deform suitably and can be carried out. Drawing 17 is the top view showing other examples of the spring member 14, and drawing 18 is the IV-IV line view sectional view of drawing 17 , and attaches and explains the same sign to the same part as drawing 6 .
[0036] In this example, the coil-spring-like protruding piece 25 is arranged in the whole surface side of a substrate 24 by forming the break of an eddy line in a substrate 24, and causing this to it. Also in this example, with the protruding piece 25 by which the cantilevered suspension was carried out to the substrate 24 in end face section 25b, **** of the spring member 14 can be set up greatly and a dimension error can be absorbed thoroughly.
[0037] In addition, drawing 19 shows a modification and is the IV-IV line view sectional view of drawing 17 . this deformation ****** -- a protruding piece 25 causes like, and a direction etc. can deform suitably and can be carried out. Drawing 20 is the top view showing other examples of the spring member 14, and drawing 21 is the V-V line view sectional view of drawing 20 , and attaches and explains the same sign to the same part as drawing 6 .
[0038] In this example, a protruding piece 25 is formed by turns so that the shape of a right triangle may be mostly accomplished to a substrate 24, and a protruding piece 25 is arranged in the whole surface side of a substrate 24 by causing this. while being able to constitute skin bending stress from considering as the configuration of such a protruding piece 25 almost uniformly also in the cross-section location of protruding piece 25 throat -- the rigidity of a substrate 24 -- the need -- it can be made to fall as enough Moreover, also in this example, with the protruding piece 25 by which the cantilevered suspension was carried out to the substrate 24 in end face section 25b, **** of the spring member 14 can be set up greatly and a dimension error can be absorbed thoroughly.
[0039] As mentioned above, in each example shown in drawing 6 thru/or drawing 21 , although the protruding piece 25 of the same configuration and the same dimension is arranged uniformly, rigid distribution may be adjusted by

changing the arrangement consistency of a protruding piece 25 according to modes of an object part, such as distortion, or changing a configuration, a dimension, etc. suitably selectively.
[0040] While being able to make an edge part into rigid low structure, being able to absorb a dimension error and being able to reduce fabrication cost by arranging in the edge part of a separator the spring member 14 which was explained above, the poor contact of reactant gas leakage and the electromotive section, the crack of an electrolyte plate, etc. can be prevented.
[0041] Next, an about 13 edge plate [of a separator 1] enlarged drawing is shown in drawing 22 , and the elements on larger scale of E part of drawing 22 are shown in drawing 23 . These drawing 22 and 23 show the condition before carrying out the laminating assembly of the unit cell. In the phase before carrying out a laminating, it sets up for a long time (the height of the edge section is set up more highly than the electromotive section), and the laminating assembly of the free die length of the spring member 14 is carried out so that an electrolyte plate 2 and electrodes 8 and 9 may not contact, and a pressure is given. However, since the rigidity of the spring member 14 is set up sufficiently low, when the laminating of the pressure is given and carried out, the spring member 14 carries out contraction deformation, and the edge plate 13 and an electrolyte plate 2 contact gas by the seal force of extent in which a seal is possible. Moreover, when the spring member 14 carries out contraction deformation, contact resistance with electric electrolyte plate 2 and electrodes 8 and 9 has all possible sufficiently small forcing force, and contacts. In this case, as compared with the seal force in which a seal is possible, the electric contact resistance of all possible sufficiently small forcing force is large enough. Drawing 24 is what showed other examples of this invention, and is the enlarged drawing of the location equivalent to the A section in drawing 1 , or the B section of drawing 2 .
[0042] the edge section 131 by the side of the 1 principal plane of the separator which the subscripts 1 and 2 in drawing have distinguished the ****** separator through an electrolyte plate 2, respectively, faces through an electrolyte plate 2, and adjoins (subscript 1 side) The wire extension by the side of the electromotive section is constituted so that it may be long compared with it of the other principal plane side (subscript 2 side) edge section 132, it may lap with an electrode 9 and a current collector 7 and it may have delta. The reason constituted as mentioned above is as follows.
[0043] That is, when it is constituted so that it may lap and may not have delta and stress works to drawing Nakagami down, it is each electrodes 8 and 9, the edge section 131, and 132. The trouble of becoming weak in reinforcement and being very easy to damage on a boundary line (it being easy to be divided) arises. however, when it laps with the business shown in drawing 6 and delta is prepared, it laps and a boundary line serves as slant for delta, and to the stress of the vertical direction, reinforcement is markedly alike and improves.
[0044] Although the height of the spring member 14 and strength can be suitably adjusted as mentioned above Near spring height h1 with an electrode and a current collector, and a lap Or spring strength k1 It compares with other near them (h2 and k2), and is h1 >h2 in a free length condition. Or k1 > k2 If it sets up a crack -- being hard -- a direction -- beforehand -- pressurization -- the force will be set up, therefore, in the case of a stack laminating, the lobe of a surely long side will contact an electrode and a current collector through an electrolyte plate ahead of that of a short side, and the deformation is also restrained by in advance. Therefore, the crack may be prevented in advance, without carrying out the load of the deformation resulting from fabrication precision etc. to an electrolyte plate. At this time, a high fabrication precision of each part material becomes unnecessary, the fabrication yield improves, and fabrication cost may be reduced.
[0045]
[Effect of the Invention] As explained above, according to this invention, in the fuel cell which comes to carry out the laminating configuration of the unit cell, fabrication cost is reduced by considering a separator configuration as a sheet metal configuration. Furthermore, the dimension error of the height from the separator plate in the electromotive section at the time of a stack laminating to an electrolyte plate and edge plate height is absorbed by deformation of an elastic member by inserting an elastic member between the separator plate of the part in which a wet seal is formed, and an edge plate, and considering as flexible structure. Therefore, the crack of the leakage of reactant gas, the poor contact of the electromotive section, and the electrolyte plate at the time of a stack laminating etc. can be prevented, and improvement in the yield and lowering of fabrication cost are attained.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view which shows the fuel cell concerning one example of this invention, and is equivalent to the Y-Y line in drawing 25 .
[Drawing 2] It is the sectional view which shows the fuel cell concerning one example of this invention, and is equivalent to the Z-Z line in drawing 25 .
[Drawing 3] It is the decomposition perspective view showing an example of arrangement of the spring member of this invention.
[Drawing 4] It is the enlarged drawing showing the 1st example of the spring member concerning this invention.
[Drawing 5] It is the enlarged drawing showing the 2nd example of the spring member concerning this invention.
[Drawing 6] It is the enlarged drawing showing other examples of the spring member concerning this invention.
[Drawing 7] It is the important section amplification perspective view of the spring member in drawing 6 .
[Drawing 8] It is I-I line view drawing in drawing 6 .
[Drawing 9] It is drawing showing other examples of I-I line view drawing in drawing 6 .
[Drawing 10] It is the enlarged drawing showing other examples of the spring member concerning this invention.
[Drawing 11] It is II-II line view drawing in drawing 10 .
[Drawing 12] It is drawing showing other examples of II-II line view drawing in drawing 10 .
[Drawing 13] It is drawing showing other examples of II-II line view drawing in drawing 10 .
[Drawing 14] It is the enlarged drawing showing other examples of the spring member concerning this invention.
[Drawing 15] It is III-III line view drawing in drawing 14 .
[Drawing 16] It is drawing showing other examples of III-III line view drawing in drawing 14 .
[Drawing 17] It is the enlarged drawing showing other examples of the spring member concerning this invention.
[Drawing 18] It is IV-IV line view drawing in drawing 17 .
[Drawing 19] It is drawing showing other examples of IV-IV line view drawing in drawing 17 .
[Drawing 20] It is the enlarged drawing showing other examples of the spring member concerning this invention.
[Drawing 21] It is V-V line view drawing in drawing 20 .
[Drawing 22] It is the expanded sectional view of the edge part of the fuel cell concerning this invention.
[Drawing 23] It is an important section extention mimetic diagram in drawing 22 .
[Drawing 24] It is an enlarged drawing near the edge section of the fuel cell concerning other examples of this invention.
[Drawing 25] It is an outline block diagram concerning the conventional fuel cell.
[Drawing 26] It is a Y-Y line sectional view in drawing 25 .
[Description of Notations]
1 Separator
2 Electrolyte Plate
3 Oxidizer Gas Manifold
4 Fuel Gas Manifold
6 Oxidizer Side Current Collector
7 Fuel Side Current Collector
8 Oxidizer Lateral Electrode (Cathode)
9 Fuel Lateral Electrode (Anode)
10 Separator Plate
12 Seal Element
13 Edge Plate

14 Spring Member (Elastic Member)
24 Substrate
25 Protruding Piece

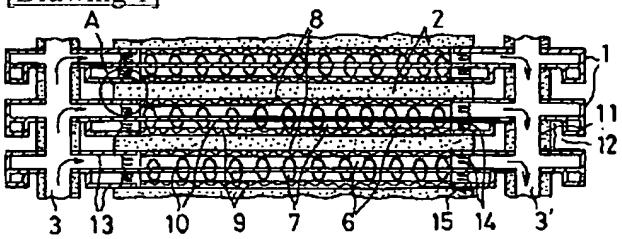
[Translation done.]

* NOTICES *

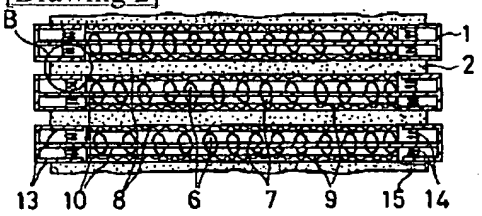
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



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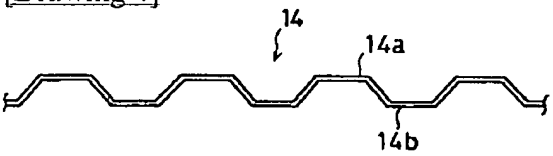

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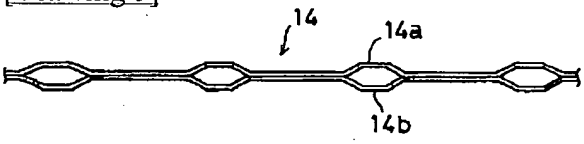
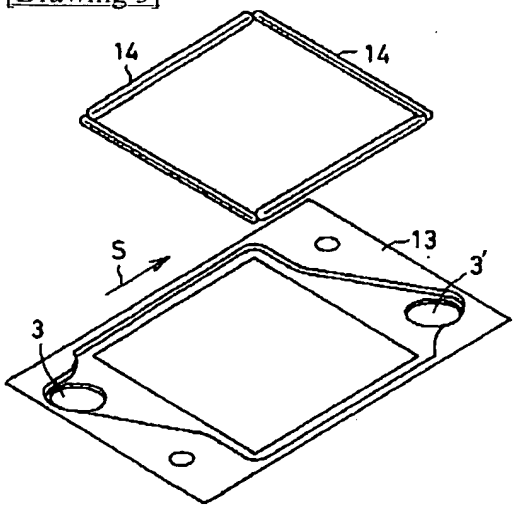
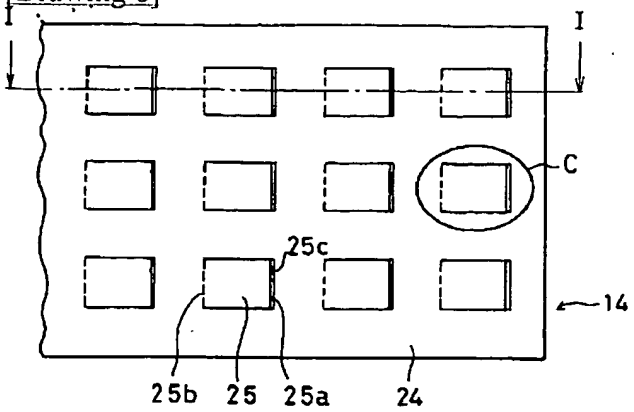


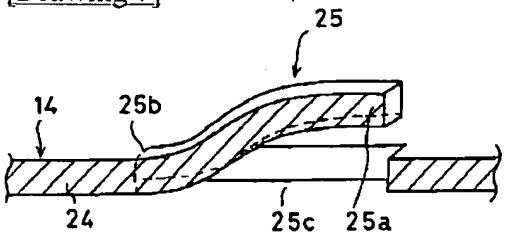
[Drawing 3]



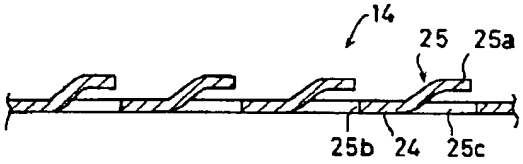
[Drawing 6]



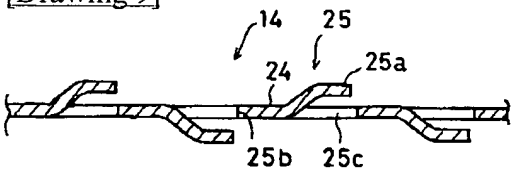
[Drawing 7]



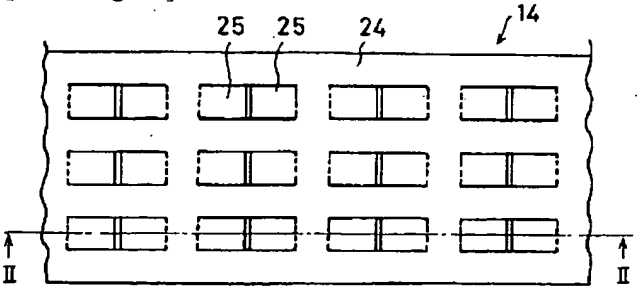
[Drawing 8]



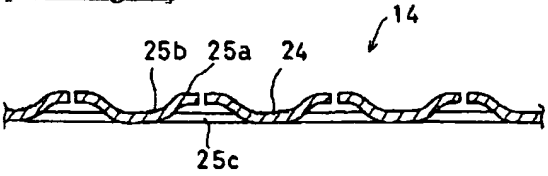
[Drawing 9]



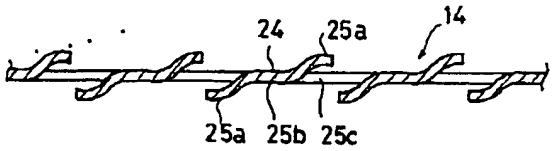
[Drawing 10]



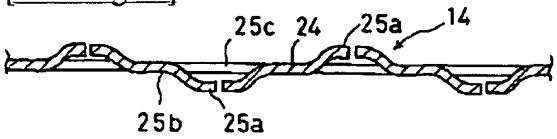
[Drawing 11]



[Drawing 12]



[Drawing 13]



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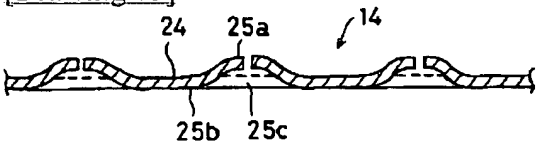

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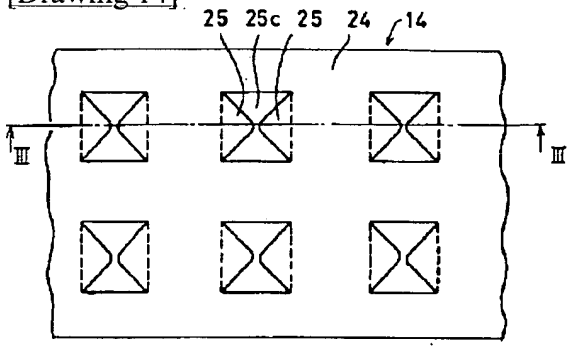

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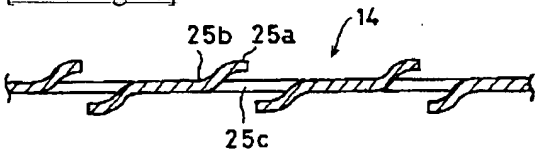

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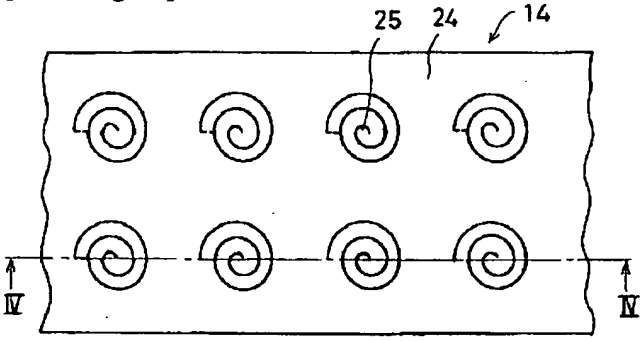
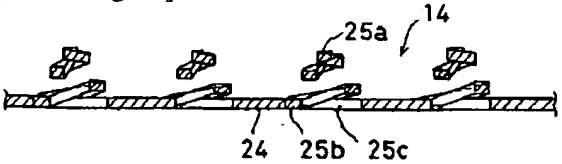


[Drawing 18]



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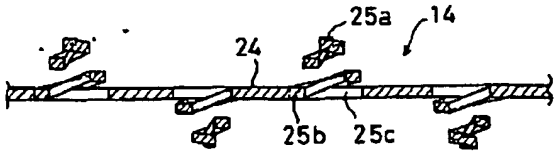

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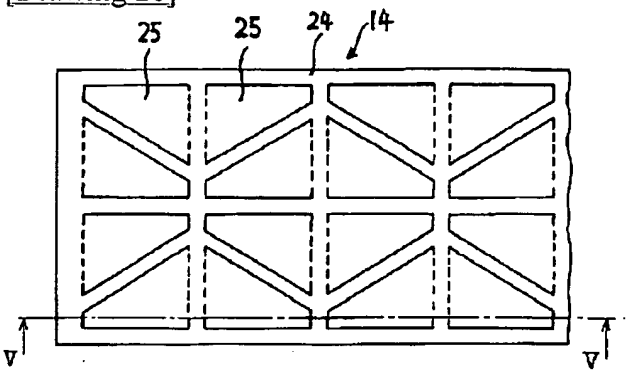
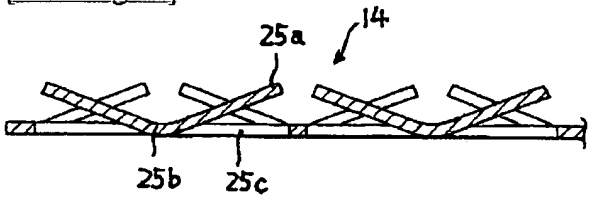
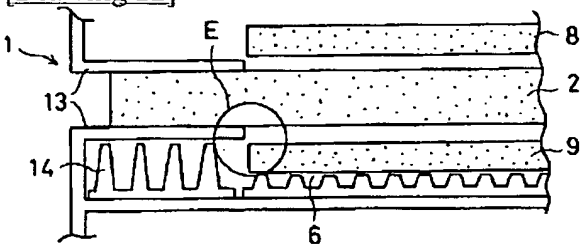


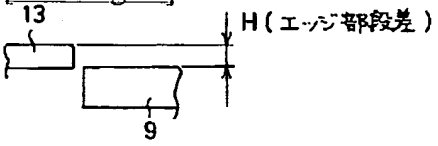
[Drawing 21]



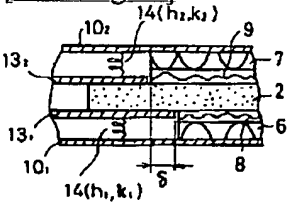
[Drawing 22]



[Drawing 23]



[Drawing 24]



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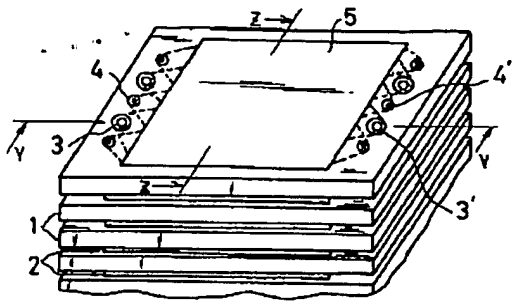
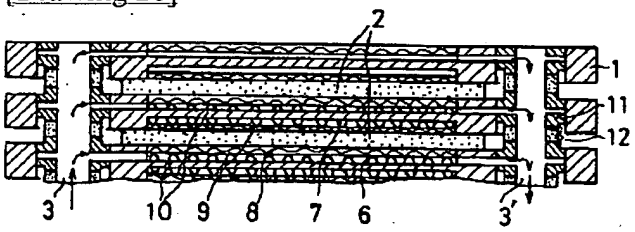


[Drawing 26]



[Translation done.]